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ABSTRACT

This instructional package, one in a series of individualized instructional units on tools and techniques for repairing worn valve guides in motor vehicles, provides practical experience for students in working on cylinder heads. Covered in the module are reaming valve guides that are oversized to match a new oversized valve, reaming valve guides to install new guide inserts, and knurling guides and reaming them to hand-fit each valve. The module consists of a teacher guide, a student evaluation, and a student guide. The instructor guide contains an introduction, performance objectives, suggested resources, suggested activities, a script for a slide presentation, and an answer key for the student evaluation. The student guide contains an introduction, performance objectives, procedures for using the module, information sheets, and an activity sheet. (KC)

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INSTRUCTOR'S GUIDE

PROGRAM: AUTOMOTIVE MECHANICS **UNIT TITLE:** VALVES

MODULE TITLE: INTRO TO VALVE GUIDE RECONDITIONING **MODULE NO.** AM-82-240

INTRODUCTION:

After completing this unit, students will be able to set up and use the tools/techniques shown. Using a junk cylinder head to practice on and then a cylinder head in need or repair, students will pick up much practical experience.

PERFORMANCE OBJECTIVES:

Upon completion of this unit you will be able to repair worn valve guides using the following tools and techniques.

1. Ream a valve guide oversized to match a new oversized valve.
2. Ream a valve guide to install a new valve guide insert.
3. Knurl a guide and ream it to size to hand-fit each valve.

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Learning Groups Designed For:

- X **Adult**
- ___ **Special Needs**
- X **Secondary**
- X **Post Secondary**

Written By:

W. Horner 8-82

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TEACHING/LEARNING RESOURCES:

1 Student Packet	_____ Videocassette
1 Instructor's Guide, Key, and Script	_____ Film Loop
1 35 mm Slide Presentation	1 Audiocassette
_____ Filmstrip	

K-D Valve Guide Reamer Set
Lisle Valve Guide Installation Kit 59000
UTP Valve Guide Knurlizing Kit
3/8" & ½" Drill
Head Stands
Practice Cylinder Head (junk yard)

INSTRUCTIONAL METHODS SUGGESTED:

SUGGESTED ACTIVITIES:

1. Ream a valve guide oversize.
2. Ream a valve guide oversized and install a new guide insert.
3. Knurlize a valve guide.

ACTIVITY SHEET
REPAIRING VALVE GUIDES

1. (a) Obtain from the shop tool room the valve guide reamers:

	Brand	Sizes	Drive Type
a.	_____	_____	motor / hand
b.	_____	_____	motor / hand
c.	_____	_____	motor / hand

(b) Obtain from your instructor a junk cylinder head and an oversized valve.

(c) With your instructor:

(1) Recondition the valve seat using the old worn guide to support the grind stone.

(2) Mark it with magic marker or prussian blue.

(d) Ream the guide oversized to fit your valve.

(1) Select another pilot and the same seat stone as in step c-1.

(2) Turn the stone about one turn on seat.

(e) Is there any difference in the seat top and bottom edge? _____

Instructor checkpoint _____initials _____date

2. (a) Drill out a ream original guide and install the new guide insert.
Caution: If your valve guide installation is not a Lisle 59000, the process might be somewhat different. Always use the manufacturer's directions.

(b) If possible, follow the same process as in steps c-1 and c-2, then d-1 and d-2.

Instructor checkpoint _____initials _____date

3. Obtain your valve guide knurlizing kit and knurlize a valve guide.
Caution: If your knurlizer set is not the same as in the slides, its use may be different. Always follow manufacturer's directions.

(a) If possible, follow the same process as in steps c-1 and c-2, then d-1 and d-2.

Instructor checkpoint _____initials _____date

KEY

STUDENT EVALUATION
Repair/Reconditioning Valve Guides

INSTRUCTIONS: When the statement is true, circle the "T."
When the statement is false, circle the "F."

T (F) 1. A valve guide seldom wears out.

T (F) 2. A valve guide has no function other than as a guide for the push rod.

T (F) 3. The only proper way to repair a valve guide is to knock it out and replace it.

(T) F 4. A worn guide can cause oil consumption.

(T) F 5. Knurlizing a guide causes it to become too tight for the valve stem.

T (F) 6. The set up pilot drills a pilot hole for the reamer.

T (F) 7. Oil, if used in this process, will clog up the reamer.

(T) F 8. A pilot hole is drilled for the knurlizer wheel to start.

T (F) 9. Knurlizing can be done only one time.

T (F) 10. Reaming a guide oversized can normally be done only once.

AM-82-240 INTRODUCTION TO VALVE GUIDE RECONDITIONING - Script

1. (Media Center Logo)

2. Introduction to Valve Guide Reconditioning

3. 1. Knurl a valve guide and ream it to fit the valve.

4. 2. Drill out a valve guide to install a new valve guide insert.

5. 3. Ream a valve guide oversized, to match a new oversized valve.

6. Engines come from the manufacturer with valve guides that are straight and have parallel sides. The seat is perpendicular to the guide, allowing the valve to seat properly each time, and do its job of sealing the combustion chamber.

7. A worn guide, on the other hand, allows the valve to strike off-seat, and the valve does not seal correctly. It will also cause rapid wear on a new or reconditioned valve installed during an overhaul.

8. Repairing the guide is essential to a good valve job. A straight guide provides an accurate pilot to the seat grinder so it can cut a concentric seat perpendicular to its guide, so the valve will close properly each time.

9. When reconditioning the head, the valve guide can be:
   1. knurled to decrease inside diameter and then reamed to size to fit the valve,
   2. reamed oversized so that a new valve with a larger stem than standard can be used,
   3. or the guide can be replaced.

10. Knurling forms or rolls a spiral groove on the inside surface of the guide until the valve cannot be put through the guide. Then, using a reamer, selected to be only slightly larger than the valve stem, the guide is reamed to fit the valve.

11. This illustrates the process, beginning with a worn valve guide, then the fully knurled guide, and finally the knurled guide which has been reamed to fit the valve. Guides can be reamed to a .0005 clearance fit.

12. Knurling allows all the valve guides to be repaired in a relatively short period of time. This process can be done on one guide only, but is usually done on all the guides, and will usually help performance.

13. The notch in the top edge of this guide is the pilot hole and it must be drilled first. This allows the knurl wheel to start into the guide.

14. These tools are used to make the pilot hole.

15. The drill stop should be set to allow the 3/16 inch drill to go to a depth of approximately 3/16 inch. Position the drill guide hole on the side of the guide away from the rocker arm.

16. Line the drill up in the guide, and drill the hole.

17. This is the pilot hole. Now, drill one on each guide as shown.

18. Select the proper size arbor, 5/16 inch, 11/32 inch, or 3/8 inch. You may encounter other sizes on diesel or other engines, but in automotive applications, these sizes are the most common.

19. These wheels roll a spiral groove down the guide. This actually raises the metal on the sides of the groove, thus decreasing the inside diameter.

20. The inside diameter is decreased until the valve stem will not fit through the guide.

21. Select the smallest arbor that will not slide or turn through the guide, usually .155 thousandths.

22. Install the arbor in the guide. Be sure to lubricate the wheel and the guide niche (the pilot hole).

23. This reduction device is used with a drill and driveshaft to turn the arbor and wheel. The wheel is canted slightly so that it will thread itself through the guide. Do not push the arbor; just allow it to thread itself through.

24. As you hold the speed reducer in one hand, squeeze the drill trigger. Remember, no downward pressure is required.

25. Be careful when the arbor emerges from the guide. If it drops onto the table or floor, the wheel may become dislodged and lost. They are expensive to replace.

26. These thread-like markings are the results of the tool moving through the guide. The guide now has a smaller inside diameter.

27. Try the valve stem in the guide. If it goes in past the keeper groove, a larger wheel is required.

28. In this case a .165 wheel has been selected to further decrease the inside diameter.

29. After reknurling the guide, again try the valve stem that is going to be used in this guide. If it <u>will not</u> fit, the guide is ready to be reamed.

30. Select the proper size reamer, based upon the size of the valve stem that was installed in the particular guide.

31. If you are using a new valve, measure the stem at mid-point, using a micrometer.

32. If you are using a reconditioned valve, you may have to settle for a straight-but-loose-guide, because the guide will have to be reamed to allow the largest area of the valve stem to pass through.

33. Measure the valve stem in the dull-colored area just below the keeper groove. This is usually the largest area of a reconditioned valve.

34. Measure the valve stem in the worn area. This reading will be used to determine the guide clearance.

35. The measurement of .341 means we will use a .341 reamer. All reamers in this kit are .0005 oversized. This means that the .341 reamer, which is .3410, is actually .3415 in diameter.

36. The worn area measurement is .337. This means that the valve has worn .004 while it was in use. The guide will still be reamed to .3415 to allow the larger section through.

37. If you subtract the guide size (what it will be reamed to) from the valve stem size (the worn area), we find that the guide to stem clearance is a very large .0045 ten thousandths.

38. This chart in the service manual shows that .0045 is excessive and that this valve should not be used as it will not seat properly.

39. This is the reamer we will use. Unlike some reamers, these are designed to be used with a drill motor.

40. Select the .341 reamer by label.

41. Insert the reamer, than insert the driveshaft. Depress the drill trigger and hold the speed reducer. Do not push reamer through. Allow it to thread itself through of its own weight and be sure to lubricate the reamer.

42. The reamer will emerge from the other end of the guide.

43. Tool steel is very brittle. So don't let a reamer fall onto the table or floor, as it could be dulled or broken. And always go all the way through the guide. Never pull a reamer back through a guide as this also dulls them.

44. The valve should fit, but if it doesn't, ream again using the same reamer. When you are satisfied that all of the guides are again within the specifications, valve seat reconditioning may begin.

45. Another procedure, replacing a guide, requires special tools and some practice. This process also can be done on one guide or all of them.

46. This is a typical valve guide installation tool kit.

47. The tool provides for three point alignment between the valve seat, the valve guide and frame adjusting screen.

48. Select the proper size spring seat adaptor to fit the valve spring boss and valve seat, respectively. Then place the spring seat adaptor on the adjusting screw frame.

49. Insert a one-half inch drill bushing into the valve seat adaptor. Select the proper size set up pilot, 5/16 inch, 11/32 inch, or 3/8 inch, and insert it through the drill bushing.

50. Push the set-up pilot through the valve guide into the adjusting screw bushing.

51. Tighten the adjusting screw. Be sure that the set-up pilot can be moved easily. If it appears pinched, the guide will be drilled crooked.

52. Remove the set-up pilot.

53. Insert the 31/64 inch drill bushing to the valve seat adaptor.

54. Insert the pilot drill bit through the bushing until the pilot enters the adjusting screw.

55. Install the driver in the drill,

56. and drill out the guide. Note that the drill speed will increase when the cut has been completed.

57. Remove the pilot drill and bushing.

58. Insert a 1/2 inch drill bushing into the valve seat adaptor.

59. Insert the reamer through the drill bushing,

60. and ream the hole.

61. Remove the drill, bushing, frame, and both adaptors. Lubricate the reamed hole with a light oil to ease the installation of the new guide.

62. Using the proper guide drift, drive the guide sleeve into the hole until it is flush with the boss.

63. Note the excess sleeve length.

64. This is the spot facer. It is used to remove the excess sleeve length.

65. The guide pin shown installed in the guide will keep the spot facer on target.

66. Cut the valve guide to length.

67. Now the new guide is flush with the original casting. The filings must be cleaned out before installing the valve.

68. The new guide is straight--clearance is within specifications and repair of the valve seat could now begin.

69. The third procedure, reaming the guide oversized, is a costly process because new valves with oversized stems must be purchased, and the machine work must be paid for. The total cost may be higher than other processes.

70. Here are two valves. The left one is standard; the one on the right is standard except for the stem which is .005 larger than the standard valve.

71. These reamers are all oversized 0.005 to 0.030 and are hand-operated.

72. Select the proper size reamer, insert it into the guide, and lubricate it with a good cutting oil.

73. Turn the reamer all the way through the guide. Never turn it backwards or pull it back up through the guide.

74. After reaming, install the valve. You can ream oversized for one valve or for the entire head. But, the more you do, the more expensive it is. So, save this procedure for use as a last resort.

75. The three methods of valve guide repair we have discussed so far all apply to cast iron heads. The procedure for aluminum heads is different, however, because aluminum heads use steel sleeved guides.

76. The guide sleeves are removed with a driver and hammer from the deck side of the head.

77. They are installed in the same manner except from the cam side of the head.

78. Be sure that the new guide is driven in to the depth required by the specifications.

79. Here is a summary of the valve guide procedures in this module:

80. You have seen how to knurl and ream a guide to re-use the original valve,

81. how to install a new guide,

82. and how to ream a guide for a valve with an oversized stem.

83. Repairing the valve guides is an essential part of a good valve job, because the guide provides an accurate pilot when reconditioning the valve seat, and helps prevent undue or rapid wear on the new or reconditioned valve that will be installed.

84. (Credits)

85. (Disclaimer)

86. (Rewind)

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T F 6. The set up pilot drills a pilot hole for the reamer.

T F 7. Oil, if used in this process, will clog up the reamer.

T F 8. A pilot hole is drilled for the knurlizer wheel to start.

T F 9. Knurlizing can be done only one time.

T F 10. Reaming a guide oversized can normally be done only once.

STUDENT GUIDE

PROGRAM: Auto Mechanics **UNIT TITLE:** Valves

MODULE TITLE: Intro to Valve Guide Reconditioning **MODULE NO.** AM-82-240

PERFORMANCE OBJECTIVES:

Upon completion of this unit you will be able to repair worn valve guides using the following tools and techniques.

1. Ream a valve guide oversized selecting the proper size to match the replacement valve.
2. Ream a valve guide oversized and install a new guide insert.
3. Knurl a guide and ream it to size to hand-fit each valve.

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INTRODUCTION

After completing this unit, you will be able to set up and use the tools/techniques shown here. Using a junk cylinder head to practice on and then a cylinder head in need of repair, you will pick up much practical experience.

PROCEDURES

1. Read the objectives and introduction to this module.
2. If you feel you can pass a test over the objectives with 90 percent or better accuracy, ask your instructor for the pretest.
3. If you do not take the pretest or do not meet the minimum requirements on the pretest, continue with the next procedure.
4. Study the information sheets which are part of this learning packet.
5. Observe and listen to slide/tape presentation AM-82-240, Introduction to Valve Guide Reconditioning.
6. For additional information, refer to the following resource:
   a. Stockel, Martin W., Auto Mechanics Fundamentals, The Goodheart-Willcox Co., Inc., 1978.
7. Review the objectives to be certain you understand what you are expected to have learned. Performance of the objectives will be evaluated on the posttest.
8. Ask your instructor for the test over this module. You are required to achieve at least 90 percent accuracy.

INFORMATION SHEET NOTES

VALVE GUIDES

Two kinds of valve guides are in general use today.

The most common on today's larger engines is the integral type, this is also true of the engines built in the past. This was due to the material, which was cast iron.

The small engines that are being used today are not only being made smaller--4 cylinder versus 8 cylinder--they are also being made lighter. Instead of a cast iron and integral valve guide, they are made of aluminum with replaceable valve guides.

The valve guide performs three functions. First, it provides a bearing surface on which the stem can slide. Second, it carries heat from the stem to the engine cooling system. Third, it centers the valve head exactly in its seat. If the head is not properly centered, it will not seal properly. If this alignment gets bad enough to prevent a gas tight seal combustion, pressure will be lost with a resultant loss of power. The escaping gases can, due to their extreme high temperatures,burn both seat and valve face. This process can carry on to the extreme where the valve head can actually break off causing catastrophic damage.

INFORMATION SHEET

NOTES

Guides wear due to the fact that the rocker arms tend to exert a sideways thrust on the valve stem. In time this causes both ends of the valve guide to wear in a funnel-shaped or bell-mouthed pattern. Most guides are designed to be seven times larger than the inside diameter. While this will not stop the wear; it will minimize it.

When valve guide reconditioning or replacement is required, this must be done before attempting to recondition the valve seats. This is necessary to maintain the correct relationship between the valve guide and seats.

Several methods of restoring correct valve stem to guide clearance are employed. On engines with replaceable guides, guides are removed with a press or driver and new guides are installed to the correct depth. Valves with standard diameter stems can be used.

On cylinder heads with integral guides, they can be reamed to an oversize for which oversized stem valves are available. This process can be done several times as the after market supplies several sizes of oversized stem valves. How often this can be done is dependent on how bad the wear is. Another method is to machine the guides to allow new valve guide inserts of standard diameter to be installed.

INFORMATION SHEET NOTES

Another method, known as knurlizing, is also used to recondition valve guides. The appropriate knurling tool is inserted in the guide and spun by hand or special drivers. This causes it to spin its way down through the guide causing a spiral thread to appear on the side walls of the guide. This tool does not remove any metal such as a tap might, but rather displaces the metal to reduce valve guide diameter. After knurling the guides are reamed to a diameter which will reduce the valve stem to guide clearance. This will produce proper guide to stem clearance so that the valve will seat properly and oil will not get past the guides into the combustion chamber.

ACTIVITY SHEET
REPAIRING VALVE GUIDES

1. (a) Obtain from the shop tool room the valve guide reamers:

	Brand	Sizes	Drive Type
a.	_____	_____	motor / hand
b.	_____	_____	motor / hand
c.	_____	_____	motor / hand

(b) Obtain from your instructor a junk cylinder head and an oversized valve.

(c) With your instructor:

(1) Recondition the valve seat using the old worn guide to support the grind stone.

(2) Mark it with magic marker or prussian blue.

(d) Ream the guide oversized to fit your valve.

(1) Select another pilot and the same seat stone as in step c-1.

(2) Turn the stone about one turn on seat.

(e) Is there any difference in the seat top and bottom edge? _____

Instructor checkpoint _____initials _____date

2. (a) Drill out a ream original guide and install the new guide insert.
Caution: If your valve guide installation is not a Lisle 59000, the process might be somewhat different. Always use the manufacturer's directions.

(b) If possible, follow the same process as in steps c-1 and c-2, then d-1 and d-2.

Instructor checkpoint _____initials _____date

3. Obtain your valve guide knurlizing kit and knurlize a valve guide.
Caution: If your knurlizer set is not the same as in the slides, its use may be different. Always follow manufacturer's directions.

(a) If possible, follow the same process as in steps c-1 and c-2, then d-1 and d-2.

Instructor checkpoint _____initials _____date